Journal of the Society of Arts.

FRIDAY, MARCH 30, 1855.

EXHIBITIONS.

The members are reminded that the Seventh Exhibition of Inventions will be opened on Saturday evening next, with a conversazione of the members and their friends, for which cards of invitation have been issued. A catalogue of the Exhibition forms a supplement to this number of the Journal. On Monday, the Exhibition opens to the public, and will remain open daily from ten till four o'clock, closing at the end of the month of April. On the 23rd of May, the Collection of Raw and Manufactured Animal Produce (Trade Museum) will be opened, with a paper by Professor Solly, " On the Mutual Relations of Trade and Manufactures."

CHALON EXHIBITION.

The Council have great satisfaction in announcing that, in continuation of the plan of collecting for exhibition the works of our eminent English painters, as already illustrated in the works of Mr. Mulready, R.A., and Mr. Etty, R.A., they are preparing this season to exhibit, in the Society's Rooms, with the kind assistance of Mr. Alfred Chalon, R.A., the works of his esteemed late brother, Mr. John Chalon, R.A., together with a selection from his own works.

FIFTEENTH ORDINARY MEETING.

Wednesday, March 28, 1855.

The Fifteenth Ordinary Meeting of the One Hundred and First Session, was held on Wednesday evening, the 28th inst., Joseph Glynn, Esq., F.R.S., in the Chair.

The following Candidate was balloted for, and duly elected an Ordinary Member :—

King, David.

The Paper read was

THE UTILIZATION OF THE MOLTEN MINERAL PRODUCTS OF SMELTING FURNACES.

By Dr. William H. Smith, of Philadelphia, U.S.

The paper which I have been invited to read, is " On the Utilization of the Slags or Molten Mineral Products of Smelting Furnaces." The term " slag" has been defined by most standard authorities as the " refuse vitreous products of smelting furnaces." This definition, being only applicable to slag in its altered conditions, after having been rendered brittle and worthless by improper treatment subsequent to its withdrawal from the smelting furnace, we reject as erroneous.

Indeed, it would be as fair and philosophical to limit mathematics to the " science of right-angles," or chemistry to the " art of dyeing wool," as to limit an extensive class of mineral products, which under proper treatment is susceptible of a wonderful variety of forms, combinations, colours, and vitreous or devitrified properties, to one single and most objectionable condition, viz., that of a refuse vitreous and brittle substance.

In order to be fairly viewed and justly appreciated, slag must be considered both in its molten state, as a fused mineral product, and in the variety of combinations, forms, and general properties it may be made to assume, under scientific treatment, subsequently to its removal from the smelting furnace. The first general view which slags, thus considered, naturally presents, is that which relates to their scientific interest. This we will briefly notice, before passing to consider a more important aspect, viz., their commercial value.

In the wide range of geological science, we find but few general phenomena which cannot be elucidated by the chemico-mineralogical transformations of the smelting furnace. Toiling amid the vast laboratory of nature in deciphering the rocky hieroglyphics of consecutive ages, or perusing the diversified characters of modern formations, the geologist finds it no easy task to reconcile the seeming contradictions, or account for the almost infinite varieties that occur in the form, position, colour, density, brittleness, hardness, softness, amorphous or regular crystallisation, vitreous or devitrified structure, and other characteristics of the mineral kingdom. In the smelting furnace, by the study of existing operations, agencies, and laws, he finds a clue to the geological history of the earth, an exponent of those laws and phenomena which have modified and determined the condition of the rocky crust of the globe. He has but to build his cupola and start his blast, and he is at once ready to daguerreotype, or rather reproduce, although in miniature, the mountainous deposits and diversified formations of igneous rocks; and if his researches verge upon chemical science, he has but to study the agency of heat in altering the form, colour, and other properties of matter, and carefully to observe the influences that determine the crystalline or amorphous structure of slag, or those wonderful chemical affinities that bind together in definite atomic proportions the elementary molecules of slag, however complex the combinations it may assume under the smelting operation. We regret, however, to be compelled to add, that much of this scientific interest has been overlooked by the metallurgist, to the no small detriment of the practical details of his art, and the enormous waste of most valuable material.

In discussing the commercial value of slag, for which we trust our previous remarks have in some degree prepared the way, we propose a fivefold argument, to wit—

1st. The value of that class of mineral formations to which slag belongs.

2nd. The regularity of the laws involved in the formation of slag.

3rd. The superior properties which slag possesses as an industrial product, especially as adapted for architectural uses.

4th. The economy of its production.

5th. The abundance of its supply.

And, first, we argue the commercial value of slag from the value of that class of rocks to which, geologically speaking, it belongs, or, in other words, to which it is analagous in its origin, and with which it is identical in its crystalline and amorphous, its vitreous and devitrified varieties of structure, and numerous other essential properties. The rocks of igneous origin are too well known to the scientific world, and too highly appreciated by the practical architect, to need enlarged description as to their character or recommendation as regards their valuable uses. They are, in a word, the rocks of which nature builds her loftiest mountains, and man constructs his most enduring monuments and palaces. We find them towering in majestic grandeur, as the oldest and most durable mountainous formations of the globe.

The Grampians in Scotland, the mountains of Cumberland and Cornwall in England, the Wicklow mountains of Ireland, the Dofrafields in Scandinavia, the Alps in Switzerland, the Pyrenees in Spain, the Oural and Hima-

laya ranges in Asia, the Abyssinian and other chains in Africa, and the Andes in South America, are all, more or less, composed of these rocks, or of primary strata, which have been thrown up and altered in mineral aspect by molten masses and veins, which present no traces of deposition or stratification, and which, like slag, are of igneous rigin.

Granite, syenite, protogine, serpentine, porphyry, basalt, felspar, greenstone, clinkstone, amygdaloid, trap-tuff, tufaceous conglomerates, lava, trachyte, obsidian, &c., are the chief varieties of these igneous rocks. The industrial purposes to which they are applied are numerous and of primary impoitance.

Now, if we admit the existence of some deep-seated source of heat to which these rocks owe their origin, and acknowledge, as we must, the analogy between them and the products of smelting furnaces, which are composed of the same elements, fused by the same igneous agency, and modified in form, colour, and character, by the same fixed chemical laws, we cannot entertain a doubt as to the value of slag as a mineral product capable of profitable utilization. And if we extend the above argument to an analytical investigation of the elementary ingredients of which slag is composed, we find additional corroboration of its validiy. Selecting, for example, the slags of iron furnaces, (which, being more abundantly manufactured than those of lead, copper, and other metals, are of greater commercial value,) we find them composed of silica, lime, and alumina, as their chief ingredients, in combination with traces of magnesia, protoxide of iron, sodium, potassium, carbon, manganese, sulphur, titanium, and phosphorus.

According to the analysis of M. Berthier, the slag or cinder of the Dowlais furnaces (from which some of the manufactured samples upon the table were made) consists of silica, 40·4; lime, 38·4; alumina, 11·2; magnesia, 5·2; protoxide of iron, 3·8; and a trace of sulphur. Slags from the Dudley furnace, and others from St. Etienne, in France, presented similar analytical results, varying slightly as to the relative quantities of manganese and sulphur. A mean average of the anthracite furnaces of America, consists of silex, 51; lime, 21; and alumina, 15; and although by reference to the more extended tabular statistics upon the Pantograph, page 337, it will be seen that the proportions of these ingredients vary slightly in the analysis of the cinders of charcoal, coke, and anthracite furnaces, yet these variations are too slight to affect our present argument.

Now regarding silica, lime, and alumina as the chief constituents of slag, we are furnished with the very ingredients out of which nature has fashioned and annealed nearly all the valuable building material of the mineral kingdom. "The rocks of our globe," says Professor Dana, in his standard treatise on Mineralogy, "are made up of about 13 of the 59 elementary substances found in nature. These are the GASES, oxygen, hydrogen, nitrogen, chlorine; the NON-METALLIC ELEMENTS, carbon, sulphur, silicon; the METALS, calcium, sodium, potassium, magnesium, aluminum. The element silicon, combined with oxygen, forms silica, combined with lime, it forms nearly all the other mineral ingredients of granite, mica-slates, volcanic rocks, shales, sandstones, and various soils. No element, "he adds "is, therefore, more important than this in the constitution of the earth's strata; and it is especially fitted for this pre-eminence by its superior hardness, a character which it communicates to the rocks in which it prevails. Next to silica rank lime and carbon."

Professor Phillips, in his mineralogical work, remarks:—"But if we look more narrowly into the composition of the crust of the globe, as consisting chiefly of the earths and earthy minerals, we shall find that only three of the earths which have been discovered, viz., silica, alumina, and lime, are found to constitute its great bulk."

And here let me remark that a second powerful argument in favour of the commercial value of slag, is adducible from the uniformity and infallibility of those laws of chemical affinity, which are alike involved in the mineral formation of nature—and in the mineral formations that continually occur, although upon a smaller scale, in the smelting furnace. By reference to the Pantograph illustrative of the decomposition and recompositions of the smelting furnace, it will be seen that the chemical changes that take place during the reducing process, are numerous and important. Yet it must be remembered, that there is no change, however simple or complex, that is not uniformly regulated and infallibly determined by one and the same law of nature, viz., that of chemical equivalents.

By this law the elements which combine to form cinder, are invariably united in definite proportions. It is well-known to every ironmaster, that a certain amount of silex or acid, when associated with the ore from which metal is to be extracted, requires the saturation of a certain amount of base, such as lime or magnesia, or protoxide of iron in order to liberate the metal, and leave no base or acid uncombined. And it is a proposition equally as familiar, that a large surplus of acid or alkali in the furnace will prove refractory and obstruct the smelting operation.

From the above law, then, it results that slag, as a mineral compound, must and can only be formed by the intimate chemical union, in definite atomic proportions, of the various earthy ingredients which enter into its composition. So important is this principle of chemical equivalents, that it not only constitutes one of the strongest links in the chain of analogy between slag and igneous rocks of natural origin, but it also affords a sure guarantee, that it is possible to impart to slag the same valuable properties by which igneous rocks are characterized, provided that the treatment of slag subsequently to its withdrawal from the smelting furnace be in accordance with those natural laws and agencies which are known to modify the form, colour, and crystalline arrangement of minerals whilst passing from a molten to a solid condition.

Again, we would argue the commercial value of slag, from the superior advantages it possesses as an industrial product, and especially from its superior fitness for architectural purposes. In the utilisation of slag, by the processes of refining, casting, pressing, rolling, moulding, and annealing, we can avail ourselves of the facilities afforded by the extremely liquid molten state to which the slag is reduced in the smelting furnace, so that we have only to prepare suitable appliances to be able to impart to it any desired form, colour, or texture.

According to the treatment it receives, slag can be rendered brittle or tough, hard or soft, compact or porous, rough or smooth. It can be cast into as great a variety of forms, solid and hollow, as iron itself, with the superior advantage of being susceptible of the admixture and blendings of colour, so as to render it equal in brilliancy to agate, jasper, malachite, the variegated marbles, and other more valuable varieties of the mineral kingdom. When properly annealed, it can be made to acquire a surface, or texture, at least ten times as durable as that of marble, and is susceptible of a polish equal to agate or cornelian.

As a building material slag can be readily adapted to any variety of aichitectural design, from the simple slab to the most ornate and complex decoration; whilst its beauty and durability chiefly recommend it as an article of luxury.

Possessing the above properties, and being capable of application to a thousand uses, the question of the value of slag finally resolves itself into a question of economy of production and abundance of supply. Now in both these essential elements of commercial value slag offers unusual advantages. The economy of production may be shown both relatively and directly. Thus, by calculating the relative cost of bricks or blocks of slag, as compared with that of ordinary clay brick, we can arrive at a proximate result, if we simply estimate, in both cases, the cost of the raw material, and the amount of time and labour spent in the consecutive stages of the manufacturing.

PANTOGRAPH.

EXHIBITING THE

MINERAL CHANGES AND FORMATIONS OF THE SMELTING FURNACE.

	Materials.	Elements.	Equivalents.
Atmospheric Air, Composed of		Oxygen	8
		Nitrogen	14
	Steam	Oxygen	8
		Hydrogen	1
	Carbonic Acid	Oxygen	8
		Carbon	6
Iron Ore, Composed of.		Iron	28
		Oxygen	8
	Carbonic Acid	Oxygen	8
		Carbon	6
	Silex	Oxygen	8
		Silicium	21·35
	Alumina	Oxygen	8
		Aluminum	13·69
	Manganese	Oxygen	8
		Manganium	19·67
	Lime	Oxygen	8
		Calcium	20
		Phosphorus	32·02
		Sulphur	16
Fuel, Composed of.		Carbon	6
		Hydrogen	1
		Nitrogen	14
		Oxygen	8
		Potassium	39
	Silex	Oxygen	8
		Silicium	21·35
		Sulphur	16
Flux, Composed of	Lime	Oxygen	8
		Calcium	20
	Carbonic Acid	Carbon	6
		Oxygen	8
	Silex	Oxygen	8
		Silicium	21·35
	Alum	Oxygen	8
		Aluminum	13·69

PRODUCTS.

1.—*Tunnel Head.*

Carbonic Acid.
Carbonic Oxide.
Steam.
Hydrogen.
Metallic Oxides.
Metallic Vapours.

2.—*Upper Hearth*
SLAG.

Silicates.
Aluminates.
Carbonates.
Phosphates.
Sulphurets.
Phosphurets.
Lime.
Protoxide of Manganese.
Protoxide of Iron.
Potash, &c.

3.—*Lower Hearth*
IRON.

Iron.
Carbon.
Silicon.
Manganium.
Phosphorus.
Sulphur.
Nitrogen.
Aluminum.
Calcium.

COMPOSITION OF CINDER, OR SLAG.

	Charcoal Furnaces.							Coke.			Anthracite.		
	Peroxide Ores.			Sparry Carbonate Ores.				Carbonates of the Coal Formations.					
	1	2	3	4	5	6	7	8	9	10	11	12	13
Silica	51·84	63·6	31·1	52·0	71·0	37·8	49·6	40·6	43·2	35·4	50	58	51
Lime	21·80	24·0	14·1	30·2	7·2			32·2	35·2	38·4	30	22	21
Magnesia	4·82	1·2	34·2	5·2	5·2	8·6	15·2		4·0	1·5		10	4
Alumina	15·21	3·8	8·9	5·0	2·5	2·1	9·0	16·8	12·0	16·2	17	6	15
Protoxide of Iron	3·73	1·7	1·0	1·6	5·0	21·5	0·4	10·4	4·2	1·2	3	2	5
Do. of Manganese	1·16	3·9	4·4	4·7	6·5	29·2	25·8			2·6		2	Traces.
Oxide of Titanium			9·0										
Sulphur			Trace.			Trace.				1·4		Traces.	
Phosphoric Acid		Trace.											
Carbon											Traces.	Traces.	
Potash													Traces.
REMARKS.	Average cinder of good iron	Bog ore cinder	Swedish Furnace	Furnace in France	Savoy Furnace, in bad condition	German Furnace, in bad condition	German Furnace, in good condition	Furnace in Wales	" "	" "	Pennsylvania Furnace	"	"

In making bricks of slag the raw material costs less than nothing, inasmuch as the ironmaster saves by its utilisation the heavy expenditure now attendant upon its removal from the furnace premises. In fusing slag to prepare it for the operation of casting no expense is incurred, inasmuch as this item of expenditure is charged by the metallurgist to the metallic and not earthy products of the smelting operation. In casting and annealing slag the processes are as simple, expeditious, and economical as in those of pressing and annealing clay brick.

Now, in making bricks of clay (the cheapest analagous manufacture that could be selected), the elements in our calculation become more numerous. The raw material has an intrinsic value, while the consecutive operations of digging the clay, preparing it for use, and transporting it frequently, added to the processes of pressing and annealing it, consume at least twice as much time and labour as that employed in working slag. From these simple, yet clear data, we can fairly infer that the cost of making clay brick will be double that of making blocks, tiles, or more decorative and valuable articles from slag. By extending this calculation to other products, such as marble slabs, columns, carved architectural ornaments of stone, &c., and in our estimate contrasting the plastic power of fusion available in slag with the laborious hewing and fashioning by mechanical means required for blocks of marble and other stones, we may arrive at still more satisfactory results in proving the commercial value of slag.

A direct calculation, however, based upon practical manufacturing operations, may perhaps prove still more satisfactory; and the following estimate of the cost of manufacturing 40 tons of slag per diem, to which is added the number of square feet of surface contained therein, and the value of the manufactured article, may be regarded as a safe approximation to the real economical commercial value of slag.

In manufacturing 40 tons of slag daily, we require an outlay for building and machinery as follows:—

Cost of erecting 40 ovens	£1,600
,, steam-engine	1,500
,, casting tables	200
,, rolling ditto	200
,, moulds	300
,, sheds	300
,, bars or refining furnace	300
,, apparatus for machinery	300
,, contingencies, wear and tear, &c.	300
	£5,000

Daily expenditure in wages, &c,—for 24 hours:—

4 furnace men
18 moulders
11 firemen
4 stokers
8 packers
—

	£.	s.
45, at 4s. per day	9	0
Overlookers	1	10
Gen. superintendant and office	3	10
8 tons of coal, at 6s. 6d.	2	12
Wear and tear	4	0
	20	12
Freight, at 15s. per ton	30	0
	£50	12

There are 180 square feet of material of one inch thickness to the ton; and 120 square feet at 1½ inch. Forty tons would produce 7,200 feet at 1 inch, and 4,800 feet at 1½ inches thickness.

Grinding and polishing costs 3d. per foot extra, if appropriate machinery be employed, or £2 5s. per ton at 1 inch, and £1 10s. at 1½ inch thickness.

If the manufactured slabs or tiles were sold in the proportion of one-fourth polished and three-fourths rough, and the former realised 1s. 6d. per foot, and the latter only 4½d., then forty tons at 1 inch would produce £236 5s.; and at 1½ inch would produce £157 10s.

Or, 100 tons would produce at 1 inch £590 12s. 6d.
,, ,, 1½ inch £393 15s.

	£	s.	d.
Commercial value of 100 tons, at 1 inch, gross	590	12	6
Less cost	126	5	0
	£464	7	6

Value of annual product at 500 tons per day, £696,562 10s.

	£	s.	d.
Commercial value of 100 tons, at 1½ inch, gross	393	15	0
Less cost	126	10	0
	£267	5	0

Value of annual product, at 500 tons per day, £400,875.

In the above calculation we have estimated the manufactured material, when polished, as worth 1s. 6d. per foot. This estimate, however, essentially varies in accordance with the form into which the material is cast;—the ornaments, patterns, and variety of colour imparted to it, and the uses for which it is designed. Thus, when cast into the form of table-tops, or architectural ornaments, it becomes worth from 6s. to 20s. per foot, while the cost of manufacturing is but little augmented.

We have preferred, however, to base our calculation upon such a minimum price as will show the value of the material even when applied to the most ordinary uses.

To enter into the details of the processes employed in the manufacturing of slag, is foreign to the design, and incompatible with the limits, of the present paper. My own system of utilization of the products of smelting-furnaces has been for years before the public, and being described in several lengthy specifications, it is not necessary for me to dwell upon its peculiarities. It may not be amiss for me, however, briefly to notice the most important desiderata towards the successful treatment of these products. The quality of the slag, as with the quality of iron or other reduced metal, essentially depends upon the proper management of the smelting-furnace. The suitable admixture of fluxes—the proper regulation of the heat, &c., being, however, of primary importance in making good metal, generally receive adequate attention, and I believe the best managed furnaces of the world are those which I have met with in Great Britain.

Great care is required in the withdrawal of the slag from the furnace, to prevent the incorporation or mechanical admixture therewith of miscellaneous debris, loose cinder, or other foreign ingredient. Such an admixture produces a heterogeneous material which (as may be seen in the rough blocks cast directly from the furnace mouth, for many years past, at copper and at some iron works,) is not susceptible of polish, and soon changes its appearance on exposure to the air. By withdrawing the slag at stated intervals, say once every hour, it can be obtained in better condition than if allowed to run out of the furnace in a continuous stream.

After its removal from the furnace, the liquid slag should be carefully refined, either by mechanical subsidization or chemical treatment, in order to regulate its specific gravity, and thus ensure a homogeneous product

Other essential elements of success consist in the protection of the moulten and hot material from the sectional polarization of its heat, or thermal-electricity; the employment of suitably-constructed moulds, made of the best non-conducting materials; the proper construction of the ovens for annealing; the regulation of the temperature of the ovens, so as to ensure a vitreous or devitrified product, as may be desired; the employment of

the proper alkalies and acids for varying, when requisite, the colour, texture, and other properties of the slag; and, suitable appliances for rolling, pressing, stamping, grinding, polishing, &c.

By examining the beauty and durability of the manufactured material as seen in the samples upon the table, some of which I have made from the slags of American furnaces, others from furnaces in England and France, it will be seen that the estimate set upon its commercial value in the above calculation is by no means extravagant.

The chief commercial value of slag, however, arises out of the abundance of its supply. The iron smelting works of Great Britain, annually produce some 6 to 10,000,000 tons of slag. If to this we add the amount of slag, likewise available, yielded in the reduction of ores of copper and lead, without considering zinc and other metalliferous sources, the supply is found to be sufficient to create a new channel of productive industry, almost, if not entirely, equal in extent, interest, and importance, to any that now affords employment to the capital and labour of civilised nations.

To the metallurgist, the chemist, and the political economist, the field of scientific research and industrial enterprise, which, by your kind permission, we have attempted to explore this evening, although novel, cannot fail to be other than attractive.

The existence of an uncultivated, yet productive source of mineral wealth, a source which if viewed in all its national advantages, is of more intrinsic value than all the gold fields in either the old or the new world, has, we trust, been satisfactorily demonstrated. The elements mainly required, in order to develop its now despised treasures, are energy and skill. Of capital, but little is required in addition to that already invested therein, although unprofitably, by the metallurgist, while its claims upon the industrial energies of the world, as already presented, and which I beg permission briefly to recapitulate, are:—

a. The scientific interest which invests the mineral changes and formation of the smelting furnace.

b. The commercial value of slag or the mineral products of the smelting furnace, as demonstrated from—

1. The importance of the rocks of igneous origin, to which they are analagous, and with which they must be geologically classified.
2. The regularity and uniformity of the chemical laws involved in their formation.
3. The superior properties which they possess as an industrial product, especially in their adaptedness for architectural uses.
4. The economy of their production.
5. The abundance of their supply.

DISCUSSION.

The Chairman remarked that the paper with which they had been favoured was one of great importance. No one who had not visited the extensive ironworks of Staffordshire and South Wales, such as those of Mr. Crawshay and the late Sir John Guest, and had not seen the cinder tips, as they were called, rivalling in size the surrounding hills, could conceive the enormous quantity of material, that was thrown to waste. The quantity of this material resembling lava, might be understood in this way. The iron made in this country annually was about 3,000,000 of tons, and the quantity of lava, so to speak—for it was neither glass nor stone, but something between the two—had been estimated at two tons of slag to one ton of iron. Many attempts had been made to render this material commercially useful, but hitherto without much success; and, therefore, he thought no one present could have failed to have listened with interest to the paper of Dr. Smith. It, however, appeared to him (the chairman) desirable, before the discussion commenced, that Dr. Smith should favour them with a general statement as to the mode of operating upon this material to produce the specimens exhibited; the meeting would then, he thought, be in a better position to discuss the subject. He had been told that this was not a mere experiment, but that in the United States of America it had been carried out commercially to a very considerable extent.

Dr. Smith said, in compliance with the wishes of the Chairman, he availed himself of the opportunity for further explanations of the process by which he purposed effecting the economical utilization of slag. The process, as already stated, was based upon the philosophical and chemical principles developed in the paper just read, and, although simple, it necessarily called into requisition—in the various processes of casting, rolling, pressing, annealing, grinding, polishing, &c.—many applications, combinations, and modifications of machinery which it would be tedious to enumerate. The main features of the process, however, consisted in the use of *pure* slag, in its most favourable molten condition—protecting the slag from all admixture of foreign ingredients, or debris—carefully refining it, so as to secure a uniform homogeneous product, and subsequently, by appropriate machinery, casting, stamping, pressing, cutting, rolling, &c. He did not use the slag by running it directly out of the smelting furnace into moulds, inasmuch as that mode (heretofore generally adopted) rendered the material unfit for adaptation to the production of articles of commercial value. He preferred to work the slag out of a chamber in connection with the furnace hearth, in which chamber the slag was allowed to accumulate for use; or, if this arrangement were attended by local inconvenience, he withdrew the slag, through covered conduits, from the smelting furnace, into a wagon or car, or large ladle. In this car it was refined by subsidization, and then run out into moulds from orifices made in the side of the car at different elevations from its bottom. The slag received from the bottom of the car was found to be more dense and valuable than that obtained from the top. This improved condition was caused in part by pressure, in part by the separation of matters in mechanical combination, and in part by the escape of uncombined gas. In making more valuable classes of manufactured articles, he substituted a reverberatory furnace for the above described car, or constructed the car so as to allow of the elevation or uniform maintenance of the heat of the slag while it was being refined, coloured, &c. The furnaces for annealing could be located near the smelting furnace, or at any desired distance therefrom, not exceeding, however, 300 yards. Different modifications of furnaces were required for different forms, sizes, and qualities of manufactured material. The grinding and polishing processes also required special adaptation of machinery. He (Dr. Smith) did not re-melt slag, inasmuch as that process would not be economical; but, for certain classes of ware, he fused or cemented together broken fragments of cold slag, by means of the application thereto of hot or molten slag. Dr. Smith stated that he could also coat or enamel with fluid slag, bricks or blocks, and various other foreign substances made of clay, iron, stone, &c.

Mr. Cameron stated that he hoped they would excuse his not expressing himself in the scientific terms used by Dr. Smith, his object being simply to explain the invention, as proved by his experience of the last twelve months. When Dr. Smith came over from America, and the invention first came under his (Mr. Cameron's) notice, he felt that, if it was what was represented, it was of immense importance, and he was determined thoroughly to test it, and accordingly, through the kindness of the proprietors of the Dowlais Works, he erected an oven, and made several very beautiful samples, fully bearing out all that was represented. He afterwards erected annealing ovens, in France and elsewhere, to test the different slags, and always with the same successful results. As the experiments were more to test *the fact* of the invention, than to make perfect materials, he was quite satisfied with the results in the rough and crude way in which the testings were conducted. Mr. Cameron proceeded to explain that

the annealing ovens which he used were not retort ovens, which were absolutely necessary to produce a perfect and uniform material, and one of the consequences was that the heat playing unequally on the ware when in the oven, caused one piece to be thoroughly devitrified, while another piece, on which the heat was not so great, was in a vitrified state. He felt certain that the invention was in its childhood, but that the resources of mind and pocket of the English people would be sure, ere long, to cause it to rank amongst the most valuable inventions of modern times.

Mr. Davison being called upon by the Chairman, said, he could confirm all that had fallen from Mr. Cameron regarding the experiments which had been carried on at the Dowlais Iron Works; indeed he had stated his views on the matter in connexion with Professor Wilson's paper on the "Iron Industry of the United States," which had already appeared in the Society's Journal. He might, however, state, by way of still further confirming the comparative ease with which the operation was carried on, that upon Mr. Cameron requiring a few additional specimens after he had left the works, the same had been prepared, according to his written instructions, by one of his (Mr. Davison's) sons, a lad fifteen years of age, then present—which specimens were then before the meeting. As to the operation or process itself, he might repeat that the slag, as it ran from the mouth of the furnace, was simply poured into rings, or moulds, of any form (the rings being placed on a heated iron plate), and when the slag so run was so far "set" as to admit of its removal from the ring, it was immediately transferred to the annealing-oven, where, after two or three hours' regulation of the heat (for everything depended on that), every aperture was then closed, and the oven, with its contents, allowed to cool down till the same had arrived at the temperature of the surrounding atmosphere, or thereabouts, when the oven could be discharged with impunity. In reference to the slag itself, as it now ran from the furnace, it was not only *useless*, but cost the iron-masters nine-pence to a shilling per ton, and often much more, in removing it from the works, besides the loss, not unfrequently, of valuable space; hence, it was not too much to say, that £150,000 or more was annually thrown away, besides the material itself, throughout the works of Great Britain. He had little doubt but common paving tiles, and the like, made of annealed slag, of one inch to an inch-and-half in thickness (without going into the matter of profit), might be delivered in London at a sum varying from 1½d. to 2½d. per superficial foot; but with regard to the polished article, it was difficult to say what it would fetch, as some of it was so beautiful as to excel the finest marble. He had only further to say, that he formed a high opinion of the subject some six or eight months since, when the experiments were going on at Dowlais, and that high opinion had continued—unabated—up to the present time.

Mr. Nesbit said, there could be but one opinion among those who had heard the paper as to its importance, when the very large amount of slag produced from the iron furnaces of England was considered. He had listened to the paper with great interest, but he thought it was not quite so new a subject as appeared to be supposed by the author of the paper, inasmuch as in 1846 or 1847, he (Mr. Nesbit) was called in professionally to advise upon the matter of making stone out of the slags of iron furnaces, and for that purpose he undertook a long series of experiments. He went to the South of France, and made experiments at the iron works of St. Etienne. He had also made experiments at some works in South Wales, and having erected an apparatus upon his own premises, he had operated upon slags from all parts of England and Scotland. The result of the experiments was that a patent was taken out in 1846 or 1847, by the parties for whom he acted, and he had brought with him a few of the specimens which were at that time produced. The process in the patent was very simply described; it consisted in moulding the slags on iron plates, and then annealing them. A large quantity of paving flags, amongst other things, were made, some of which were laid down in the Place de la Bourse, in Paris, and he believed remained there to the present day. A question had been raised with regard to the hardness of the material, and he had procured a report from the Prefect of the Seine, which showed the resistance of this material to crushing power. A number of small cubes (2¼ inches square) of granite and other materials were submitted to pressure, together with similar cubes of this lava, and the comparative resistance to crushing power of the various materials so tested was given in kilogrammes as follows. 1. Great rock of the Plain of Paris, was crushed with a weight of 4125 kilos. 2. The Lias of Bagneux, with 7238 kilos. 3. The granite of St. Honorine, with 7498 kilos. 4. Granite of Flamainville, with 8705 kilos. 5. Black marble of Italy, with 10,696 kilos. 9. The artificial lava with 17,280 kilos, equal to 12¾ tons nearly.

Professor Wilson coincided with Mr. Nesbit as to the importance of this subject, and he had no doubt that, as a movement had been made in this direction, it would not be allowed to rest till it had been investigated more thoroughly. Probably one of the highest developments of science was its application to such practical purposes as these, and the utilisation of waste substances was one of the most important problems of the day. There were some questions which it was necessary to consider with regard to the application of these slags. He could hardly go the full length with Dr. Smith on some points. He (Professor Wilson) thought the constitution of slag was scarcely so definite as that gentleman seemed to think—that unless the several ingredients were chemically combined, and the mass was perfectly homogeneous, the material was liable to be decomposed, especially by the action of the atmosphere. This point appeared to him a matter for consideration, as the author told him that he allowed the slag, after it came from the furnace, to remain a certain time till the molten matters separated into two or three different strata, and, therefore, these strata must be differently constituted, inasmuch as they made different forms of slag when cool. It appeared to him (Prof. Wilson) somewhat difficult to draw the line where those changes commenced and where they ceased, so that, unless they could obtain a perfectly homogeneous mixture, they could not operate with any certainty upon the materials which this process was intended to utilise. He thought there was also another point which required further proof, and that was one which time could only determine. He would like to see the effect which the action of continual exposure would have upon this material, after it was furnished either in the rough or in the refined and polished form. They knew that many of the ornamental stones and marbles, which were more or less the same kind of substance manufactured by nature—were, after exposure for a certain time, affected on the surface, even though polished as fine as possible. He should like to be satisfied—which could only be done by time—as to whether this substance would not be susceptible of the same influences, as if so, a great portion of its value was lost. The enormous mass of material at hand, and the little cost at which it could be worked, deserved the attention of ironmasters and of scientific men; and he, for one, begged to thank Dr. Smith for his excellent paper on the subject, which he had no doubt would, by calling attention to it, tend materially to aid in the establishment of, what he hoped he might be able to term, a new industry.

Mr. Charles May called attention to an analagous substance manufactured by Messrs. Chance, of Birmingham, from the rowley rag or basaltic rock of Dudley, which appeared to be the same sort of thing, but possibly a little more homogeneous in its composition. From this article there had been produced castings of corbels and quoins for buildings, and various other articles, which by annealing, returned to the basaltic state, or by rolling,

remained vitreous like glass, and formed a very beautiful substance. He thought the rowley rag, being more homogeneous than the slag, would be found a better article and pretty nearly as cheap. [Specimens were exhibited.]

Mr. BEARD could answer one of the matters alluded to by Professor Wilson, as to the durability of the slag in the rough. As manufactured by himself, and used for the coping of walls, and in some cases for ornamental purposes, in the town in which he resided (Taunton), it had stood for forty years, and the large pieces of coping were in as good condition as when first put up.

After a few observations from Mr. R. F. Davis,

Mr. HUGO REID said Dr. Smith had suggested the use of slag for building purposes, as it had been found to sustain great pressure. He thought it would have added to the interest of the subject if they had been informed what was the specific gravity of slag. Dr. Smith had referred to the igneous rocks as analogous in composition to slag. He might say that, for building purposes, igneous rocks had never been employed to any great extent in this country, and it would be interesting to know whether, in the United States, they had been employed to a greater extent than here. For his own part, he did not know of any town in England which was principally built of igneous rock, but he knew one or two towns in Scotland which were chiefly built of that material. Aberdeen was built principally of granite, and the little town of Galashiels, he believed, of black basalt. When they saw the small use to which igneous rock was applied in this country, it would be interesting to know whether in the United States it had been used to any great extent for building purposes.

Dr. NOAD wished to observe, in reference to what had fallen from Professor Wilson, that he had found, from numerous analyses, that the cinder from the blast furnace was very uniform in composition, however greatly the burden of the furnace might differ. When allowed to cool gradually and in large masses, fine crystals were found lining cavities in the interior of the blocks; these crystals had a composition which placed them among the auzite or pyroxene class of minerals. When the furnace was making gray iron, the composition of the slag was somewhat different; it was, however, still uniform in chemical composition and crystalline. When cooled rapidly the surface of the cinder became vitreous and extremely brittle, but when this glassy surface had cracked off, the slag underneath was as hard and as firm as a native rock; and that it would stand the weather, was proved by the fact that walls were built of it which had remained sound and firm for very many years. The uniformity of the chemical composition of the cinder, under burdens differing so widely from each other, was a striking circumstance, and greatly in favour of Dr. Smith's proposed utilization of these products. Dr. Noad wished to ask Dr. Smith for some further explanation regarding the advantage to be derived from what he termed the *subsidence* of the slag, as he had found the composition to be perfectly uniform at all times of the day.

Mr. AUSTIN, in reference to the specimens introduced by Mr. May, as the manufacture of Messrs. Chance, said it was a production from the basaltic strata, which principally abounded in the neighbourhood of those gentlemen's manufactory, and it was also found in Scotland. The disadvantage was, that it had to be dug from the earth and then conveyed to the place of manufacture, and he thought it would be too expensive to successfully compete with the production direct from the slag. He was convinced, from the valuable articles he had seen produced under a new patent, by Mr. Elliott, that slag would supersede any material which was attended with the cost and labour of digging from the earth, because the slag could be obtained at no cost at all. He had known some iron masters pay as much as 3s. 6d. per ton for conveying the slag away, which increased the price of iron. This would not be the case if the slag were convertible to useful purposes, and he was convinced that it only required the spirit and energy which Englishmen possessed, to carry it out to a very profitable result.

Dr. SMITH, in reply to the remarks of Mr. Nesbit, begged leave to state that he did not by any means wish to convey the idea that there was anything novel in the working of slag, by simply running it from the smelting furnace in its crude state, as mixed mechanically with debris, &c. That had been done in different countries for centuries past. The novelty which he referred to, consisted in the adaptation of slag, by refining it, &c., to the production of articles of commercial value. Unless refined and carefully separated from all foreign ingredients or debris, slag could not be properly annealed or profitably manufactured. And he, Dr. Smith, believed slag had not been thus utilized, either in France or any other country, excepting in accordance with the novel process which he had secured in Great Britain, France, Belgium, America, Sweden, Austria, and other countries, by several patents, comprised in specifications and claims which were too numerous to be here repeated. In reply to Professor Wilson he would simply state, that if the professor carefully examined the consecutive and continuous operations carried on in the smelting process, he would become fully satisfied that the definite union in fixed chemical proportions, would be found the only possible condition under which mineral products could be fused together. Dr. Smith further stated, in answer to the inquiries made by Dr. Noad, that the subsidization and refinement of the slag, subsequently to its withdrawal from the smelting furnace, materially affected the quality of the liquid material, inasmuch as the merely mechanical mixtures could thus be separated from those purely chemical. Dr. Smith added, in reply to the inquiries made relative to his visit to certain furnaces in Wales, that he had been kindly favoured with permission to make some samples from the slag of the Dowlais and Ebbw-vale Iron Works. These samples were now before the meeting, in the form of table-tops, &c., and showed that those furnaces yielded slag of a very superior quality, as to liquidity, colour, &c.

The CHAIRMAN was sure he was only expressing the wishes of the meeting when he said they were desirous of thanking the author for the interesting paper he had read. Many remarks had been made upon previous attempts to utilise this substance, but it might be said "he invents who perfects," and if Dr. Smith did that he would confer a great benefit upon the country.

The Secretary announced that the Paper to be read at the next Meeting, on Wednesday evening, the 4th of April, was, "The Diseases of Miners." By Mr. Herbert Mackworth, M. Inst., C.E.

COTTAGER'S STOVES.

By LADY BENTHAM.

The cookery of English housewives is notoriously inferior to that of their continental neighbours, a difference which probably originated in the kind of fuel employed in this country viz., coal, to keep up an equable small fire with which requires almost constant attention. The French woman, on the contrary, with her wood fire, can collect its embers, draw them round her soup pot or stew, leave her provisions to simmer gently without attendance, whilst she occupies herself in other business. The first step, therefore, to the improvement of English cookery should be the contrivance of a stove which, when burning coals, would enable the housewife to attend to other concerns than keeping up a cooking fire.

Many fire-places are in the market, under the name of Cottager's Stoves, several of them possessing good properties, but no one all that are desirable for even English cooking, still less for the confection of food in the palat-

able, economical manner customary in France and in other continental states; the following hints may possibly tend to the contrivance of a stove suitable for the working classes and for small economical families.

The first desideratum is, that such a stove could be manufactured at a low price.

A second desirable quality is, that it should be a bad conductor of heat in all parts surrounding the fire, excepting where its heat is required for warming an apartment, or occasionally for cooking. This property is easily attainable by forming the fire-place of fire-bricks or lumps instead of metal, as is now practised in many grates and stoves.

The next consideration would be the several services required from a cottager's stove. The principal ones appear to be the following: To heat the cottage or kitchen in cold weather; to furnish a sufficient supply of boiling water at short notice, and of tepid water at all times; to boil quickly such meats as require to be so cooked; to broil; to fry; to bake; to stew, and to make soups; to dry shoes and other apparel, without annoyance to the inmates of the cottage or kitchen; to dry linen after washing; to heat smoothing irons; to ventilate the cottage or kitchen.

Heating the apartment sufficiently may be attained by any stove constructed on the principle of an Arnott's stove, and which principle forms the basis of the subsequent suggestions.—The construction of a stove surrounded with non-conductors of heat, excepting in such parts as are required to give it off, and that with more or less rapidity; also the providing means for regulating the admission of air to the fuel, so that it may burn away with more or less rapidity, according to the degree of heat required. This is effected, as is well known, by a regulator in the furnace door, and the stove itself is rendered a slow conductor of heat, by surrounding it with a casing of sand. In like manner a cooking stove, the fire-place being of fire-brick, might have an outer shell of sand enclosed in any suitable material. The English working classes being accustomed to see and to enjoy an open fire, it might be expedient to continue this indulgence by constructing a grate in front of the fire, but closable with a door at pleasure. At St. Petersburg stove doors are habitually made double, having, perhaps, an inch of air between the inner and the outer doors, and—I forget how—the two folds are so contrived as that, by simple mechanism, they close air-tight. The front grate in *Nicholson's* stove is exceedingly convenient—it lets down so as to drop out the coals on extinguishing the fire, the back of the fire-box being a curve towards the front. Servants and cottagers, on raking out a fire, poke and beat it, smashing the coals and cinders to ashes. The coal-box recently advocated by Dr. Arnott might with great advantage be applied to feed the fire in a cottager's stove. In hot weather an outer casing of sand might be added to the sides of a stove, but evidently at an additional expense.

The exterior of stoves in this country have hitherto been of metal; but, independently of non-conducting property, on account of cleanliness glazed earthenware is far preferable. In Denmark, Sweden, and Russia, the stoves for heating apartments, at least, are universally of glazed pottery, and doubtless they are so in German states that I have not seen. So in France, the largest and the smallest stoves are of white glazed earthenware. I purchased one for 20 francs, (about 16s. English) in a provincial town in the south of that country. This stove had an iron oven in it, the heat of which was sufficient for cooking, though it was not used for more than toasting bread. There was a neat door for the oven, another for the fuel, and two or three iron bands around the body of the stove. It cannot be conceived that English potters should fail of accomplishing what in France is so generally effected; not that any stove for coals could be furnished for sixteen shillings, as a grate would be necessary, besides other conveniences that seem desirable.

Housewives are likely to exclaim loudly against me, when I condemn the usual *boiler* connected now-a-days with all kinds of cooking grates and stoves. But such boilers are, in fact, extremely wasteful of fuel; I am well convinced of their convenience, though the old-fashioned boiler slung upon its crane, always gives an ample supply of hot water, and at a boiling point when necessary. The *fixed* boiler works whether hot water be wanted or not; when boiling water is not required, it goes up the chimney in the form of steam, and it is well known that many times the heat necessary to make water boil, are absorbed in its conversion into steam. The loss of heat consequent on the attachment of a boiler to the fire-place is not known, but it must be considerable, for with fewer and much smaller fires, the same quantity of coals has been consumed since a fixed boiler was obtained with a new kitchen range, upon approved principles, and of a description in very general use. Boiling water being wanted by the cottager for tea and other purposes, an aperture should be formed over the fire large enough to admit a tea kettle; the kettle itself, though having a bottom so far flat as to ensure steadiness when set down, might have its sides flaring outwards for two or three inches, whereby the aperture in the stove would be well closed. The kettles made for a cottager's stove do indeed cover such an aperture, but they being at some distance from the fire, are long in boiling, whereas a conical kettle might be inserted enough for it to nearly touch the fire. The same aperture would serve for plain boiling of meat or vegetables, the boiling vessel being also conical at its lower part. For a constant supply of tepid water, a flat-bottomed kettle might be kept on the top of the stove. The same aperture would afford an open fire for broiling and for frying. Should a roast be required, it might be done at the open front of the fire, should that be preferred to using the oven for this purpose.

The oven would be a most essential part of the stove. The oven should be capable of being heated to the degree necessary for baking bread and pies, and also susceptible of being kept at a lower degree of heat. The oven should have a very small pipe from it opening to the chimney, this being for the purpose of carrying off steam and disagreable odours; there should also be means of conducting air to the oven in Count Rumford's way, as he found that want of air caused the inferiority of baked to roasted joints; both the pipe to the chimney and the air opening should be closeable at pleasure, by means of the ordinary rose-closure, which also enables the opening to be regulated according to need. Soups and stews of all kinds would be best cooked in the oven; they might be left therein to simmer gently for several hours without the least attendance; a piece of beef, with a seasoning of salt and spices, remained in my oven for five hours to-day, and proved excellent; many a French cook would have placed the stew-pot and its contents on the embers of a wood fire overnight, the tenderness of the meat depending on its being very gently simmered, never boiled. Professed cooks are aware of this, but the generality of English housewives fancy that a fierce fire is essential to good cookery. It is the same with soups; soup meat is tough, hard, and tasteless when it is kept boiling, but, on the contrary, the *bouilli* from which soups are made in France, is always tender and well flavoured, for it is never allowed to boil after the first skimming of the pot. These are homely matters to descant upon, but if Viscount Ebrington deems it worthy of the Society of Arts to improve the habits of the working classes, surely it is not beneath them to point out the means by which ordinary diet may be amended.

Many a cold, a fever, or a consumptive malady, originates in the sitting in wet apparel, or in exposure to the vapor in drying it, of fresh-washed linen. To obviate such mischief a drying-chamber might be formed, at little cost, in an ordinary fireplace; for this purpose a part of the chimney might be enclosed, so as to be somewhat heated by the stove, the chimney shaft, or a part of

it, being left open for the escape of moisture. Count Rumford, more than half a century ago, fitted up a drying closet in his house in Parliament-street, in which closet bed-linen and blankets were daily hung. That closet furnished the idea of the enclosure now proposed, and, by opening the door of it, a draught of air up the chimney would ventilate the cottage or kitchen more or less at pleasure.

The heating of smoothing-irons remains to be provided for. In the generality of stoves, their tops being hot plates, the irons are placed upon them; but for this purpose a great fire is necessary, otherwise the irons are not hot enough for large linen. In Mr. Strutt's laundry, at Belper, the irons sunk into a bed of sand on a hot plate, were speedily heated at a small expense of fuel, and a slight shake threw off the sand on taking them for use. In the same way a box of sand might be placed over the aperture on the top of a cottager's stove, or, where box-irons might be preferred to flat ones, the heaters might be placed between the bars of the grate when open, or otherwise put into the fire from the aperture above it.

No cottager's stove hitherto in the market is provided with means of applying fire-heat to that particular part where wanted at the moment, but this might be easily effected by a better arrangement of the flues, and by dampers upon them, to cut off the heat from parts not wanted.

Amongst the best of the present stoves is that called the Cottager's, and it is sold in many of the London warehouses; but it has the great inconvenience of being laid and lighted from an opening in the top, thus rendering it impossible to rake out cinders, or to lay the fire, without soiling the arm; were the front bars to let down this would be avoided. It is also necessary in this stove to heat the oven, although a kettle of hot water were all that was required, and the top plate is rarely hot enough for smoothing irons. Soyer's stove has the advantage of a small projection above the fire as a security against smoke from the fire-place. Nicholson's stove seems to be the best of existing ones, but it requires setting by the bricklayer. Having determined to have one of Nicholson's in my kitchen, I sent for the best builder of the place, informed him that such stoves might be seen in constant use in the Model Lodging Houses in Streatham-street, and authorised him to order *himself* such a stove for my use, that he might not lose the profit allowed by manufacturers; but no, nothing, he said, would suit me but the usual range, with its boiler and oven. I jogged on with such a one for another twelvemonth before a Cottager's stove was procured for the kitchen in question. This is mentioned as showing the desirability of contriving a stove complete in itself, without requiring any setting.

Nicholson's stove is said to have been improved upon in London, but like many other so-called improvements, for the worse, and so as to render it more costly.

There are times of the year when fire is wanted merely to boil water for tea; for this purpose, and a few others, there is already an excellent apparatus called the Batchelor's Kettle, with which a single round of the patent wood "four fires for a penny" boils a pint of water. It is sold by Spiller, 98, Holborn-hill.

Amongst the best of the present stoves, is the "Anglo-German warming and cooking stove," of Pierce, 5 Jermyn-street.

As there is some difficulty in firing large masses of pottery, especially glazed ware, and as lime cements are destroyed by great heat, it would seem expedient to compose an earthen cooking stove of separate pieces, connected with one another by clay instead of mortar. At St. Petersburgh, we had a dressing-room divided from the bed chamber by a wall of white glazed tiles; this wall containing horizontal flues its whole height; during its construction, I noticed the operations of the stovebuilders, especially whilst preparing the clay as a cement; they kneaded it for some hours with their feet, carefully picking out even the smallest pebble, which, if neglected, they said, would seriously injure the intended structure; the tiles, of perhaps 18 inches square, had been moulded with a few holes in their sides, less than the eighth of an inch diameter, for the reception of iron steady-pins, to keep the work in its place for a few days; the wall being finished, the builders gave instructions to allow a current of air to pass through it for some days, but not to make a fire in the stove till the clay should be nearly dry, then to burn it into brick by making a hot fire in the stove. It would seem that around many of our fire-places, clay would form a more durable cement than mortar, yet the builders here are averse to the substitution of clay.

For cooking in an oven, culinary vessels of pottery are preferable to any metal. Formerly the kind of pottery called "Hempel's ware," bore excessive heat without a fracture; a sort of ware much resembling it is now common, and is used as potting pans. The shapes of these are not convenient, as they are contracted at the top as well as bottom. Hempel's vessels had usually a rim at their tops to support a lid. Formerly earthern pipkins were used in every kitchen, but with their abandonment habitual use of crockery has been lost. This is much to be regretted, as carelessness of brittle things is one great source of that wastefulness in the working classes which Lord Ebrington remarked in his address of the 15th November. French women and Russians are said to be rough, but in both nations brittle earthenware is the common material of culinary vessels, which are in those countries seldom broken. I heard a French housewife sorely lament a crack in her soup-pot, which had cost 8 sous, and had "lasted so *many* years." Let not, then, the unnecessary breakage of earthenware be an objection to its use for culinary purposes; it is cheaper, and more easily cleaned when soiled than any other material; it is not susceptible of sudden change of temperatures, it is of little cost, it keeps its contents long hot; indeed, on this account a soup or stew may be served at table in the same clean vessel in which it had been cooked on a hot plate, or in an oven.

PARIS EXHIBITION.

Concurrently with the Exhibition at the Palais d'Industrie, a general exhibition of agricultural produce, to which all countries are invited, will take place in Paris from the 1st to the 9th of June next, under the auspices of the Minister of Agriculture and Commerce. A show of this kind is, it is believed, the first that has occurred in France. England will of course be expected to take a considerable part in it. A special section is destined for animals, male and female, of foreign breed, which may be brought expressly for the Exhibition, or which have already been imported into France, whether they be the property of Frenchmen or of foreigners. Cattle, sheep, pigs of all breeds and kinds, will be admitted. Fowls, turkeys, ducks, pigeons,—in a word, all the best specimens of animals of every description comprised in the term of agricultural produce, will have their places. The French Government not only invites all friendly nations to participate in this show, but will also share in paying the expenses of transport; and from the French frontier the stock of the kind mentioned coming from abroad will be brought to Paris at the expense of the State, as specified in the 16th article of the Ministerial order to that effect. It has been also decided that the expense of feeding shall be defrayed by the Government during the period of the Exhibition. Independently of a sum of about £1,000 sterling which will be expended in prizes to the successful competitors, sales, either by auction or by private arrangement, of the stock, or any portion of it, may take place, so that not only will the exhibitors enjoy the advantage of free transport and of gratuitous feeding for the cattle and other animals, but they will be enabled to effect sales on the spot, and under circumstances of the most favourable kind, when the largest proprietors and farmers are met together.

A bill has been presented to the Corps Legislatif for modifying the French patent laws with a view to the Universal Exhibition. Any exhibitor who may desire to reserve his right in his invention will be allowed to apply to the directors of the Exhibition for a certificate, instead of at once taking out his patent, and paying the first instalment of 100fr. required by the present law. This certificate will protect him for a year from the day of the deposit of the article with the committee; after that period a patent must be taken in the usual form. The bill will be applicable to foreigners as well as Frenchmen, and to articles not strictly patentable, which, under the name of *dessins de fabrique*, are regulated by a special law.

THE PATENT OFFICE.

A Free Library and Reading-room, in connection with the Office of the Commissioners of Patents, was opened to the public on Monday, March 5. The hours of attendance are from 10 till 4 o'clock.

The library includes a printed collection of all specifications filed since October 1, 1852, as well as a considerable number of those recorded under the old law.

Home Correspondence.

DECIMALISATION OF COINS AND ACCOUNTS.

SIR,—There has been pointed out to me, in a letter from Mr. Theodore Rathbone, contained in your *Journal* of the 16th inst., the following passage:—

"Between the 69·43 grains of silver constituting the franc and the 67·27 grains the English tenpence, there is, of course, literally only about two grains of difference, with a corresponding degree of difference in the dollar, &c.; and so far from there being any approach to accuracy in Mr. Miller's extravagantly wild assertions that by the proposed adjustment, I mean 'that England should abandon every one of her present measures of value, &c.,' it is not even proposed that she should abandon any one of them whatever,"

"Extravagantly wild assertions," or "assertions without any approach to accuracy," would be unpardonable upon a subject where all the facts lie before us.

The passage of Mr. Rathbone's upon which my remarks were made was the following:—

"When Great Britain has everywhere adopted the *tenpence, or twenty-fourth part of her pound sterling* as the principal denomination in all her accounts, can it be doubted that the very slight adjustment required to render *this coin* the true European franc or French tenpence, would very soon follow?"

There can be no question here, as there usually is, about Mr. Rathbone's meaning. He says, "this coin, *the twenty-fourth part of a pound sterling*," and he contemplates the changing it into a franc by a slight adjustment. Now this slight adjustment is in £1,000 upwards of £48, or nearly a shilling in the pound; and such, or, indeed, any alteration in the value of our great unit and standard of value, would necessarily leave us without one single element wherewith to connect the money of the past with the money of the future. My remarks, therefore, were neither extravagant nor incorrect, as Mr. Rathbone supposes, but plain facts, fairly and logically stated.

Mr. Rathbone now changes his ground, and states that he means by the "slight adjustment," the small amount of silver required to make an English tenpenny token equal in weight to a franc. We will grant him, for the instant, that they contain an equal quantity of fine silver. Now, what has he gained by it? He has simply—very simply—altered, not the measure, but the symbol or token for the measure, made it more costly, and thinks that he has made a universal thing; and thereupon mounts up into the seventh heaven of self-glorification, singing, as he rises—"How vast the gain to mankind of a strictly uniform and *interchangeable* silver coinage!"

Did it never occur to him, before he left the earth, to try its interchangeability? Perhaps he may be acquainted with "an order of mortals on the earth" who would exchange tenpennies, 24 to the pound sterling, for francs 25 and near ¼, to the pound; but I hope and believe that even in Liverpool such an order of simple ones is not an extensive order.

The great delusion upon this point is, that it would be any advantage to the nations of the earth that their coins should be interchangeable.

One of the great advantages of our currency is, that our silver coins remain at home. That advantage results from their being merely the legal tokens for the values they represent, and the values themselves. The United States have just now adopted our plan, and doubtless all Europe will be driven to do the same.

There would, really, be some statistical advantages in a universal money of account, but without that, a similarity of coins could be no advantage whatever. The fairest arrangement undoubtedly is, that each nation should pay for the fabrication of the money it uses, as it does at present.

I warn Mr. Rathbone off this ground. He has to learn yet the first principles of monetary science. Let him take up the cry of the "Poor Man's Penny;" it is a safer string for him to harp upon.

Mr. Rathbone further states that I am a party to a proposition to alter the value of the gold sovereign; such is not the fact. Yours, &c.,

W. MILLER.

Bank of England,
March, 1855.

SIR,—In a former number of the *Journal* I pointed out the origin of the pound-and-mil-scheme of decimal coinage. The following extract from the *Times* will show that the penny scheme is no new proposal, and that the *Times* is perfectly consistent in now advocating that measure.

In the leading article of the *Times* for the 14th June, 1816, occurs the following paragraph:—

"Since the revolution, a simple system has been adopted in France, and the coins, both of gold and silver, have been, in comparison with our own currency, perfection itself. The integral unit in this system is a piece of silver instrinsically worth about 9½d. or 9¾d. of our legal money. If, therefore, our government would coin shillings of the same intrinsic value, (that is to say, containing 69½ grains of pure silver, besides the alloy), and would make these shillings current for *tenpence*, we should have the elements of a decimal system of calculation, with little derangement of our existing accounts, inasmuch as it would only be necessary to enact, that wherever pounds sterling have been mentioned in any existing contracts, the term should be taken to mean 240 pence, or 24 shillings, of tenpence each."

This is only one of numerous articles on this subject, both before and after that date, in that paper, and many pamphlets were published on the plan in that year, but all these were overlooked by the late Parliamentary Committee. Even the desire to introduce the French system entire was advocated at the same time. In the leader for the *Times* of 31st May, 1816, the following paragraph is to be found:

"Why not at once adopt the French integer, which they call the franc, and which we may call what we please! Vast would be the benefit to commerce—vast, indeed, the convenience to individuals, if the same money substantially circulated in the two countries."

During the discussion on the new coinage in 1816, all the advocates of a decimal coinage in the House of Commons and the press, were in favour of a *tenpenny* coin. Though "Mercator" had published the pound-and-mil

scheme recommended by the late Parliamentary Committee, I do not find it recommended by a single person at that time. It was evidently considered too theoretical, and not sufficiently practical or accurate for general use. There was every probability of the *tenpenny* being adopted by the government, but a discussion arose about the gold coin, if it should be a guinea or a sovereign; and nothing further was said about the decimal coinage, and perhaps the government were annoyed at Mr. H. Goodwyn's claim for a compensation for the scheme.

Yours very truly,
JOHN EDWARD GRAY.

British Museum, 19th March, 1855.

Proceedings of Institutions.

WARE.—On Friday evening, February 9th, a lecture on Fire-Arms, was delivered at the Town Hall, to the members and friends of the Institute, on the subject of "Military and Sporting Arms," by Mr. D. B. Harvey. The lecture was well attended, and the chair was occupied by Mr. Gisby. The lecturer gave an interesting and lucid sketch of the history of fire-arms, pointing out the peculiarities of construction, with their advantages and disadvantages, of the different kinds of muskets, rifles, and pistols, which have from time to time been invented. Having briefly noticed the earlier improvements which took place in the manufacture of fire-arms, particularly the flint lock and the percussion cap, the former a French and the latter an English invention, he dwelt at greater length on the various improvements of more modern times. He fully explained the construction and mode of action of the needle gun, the Minie rifle, breech-loading guns, revolving and repeating pistols, air guns, india-rubber guns, and bulleted-cap guns; and illustrated his remarks with specimens of each kind. The needle gun which is of Prussian origin, but has been improved by English manufacturers, had not, he said, had a fair trial in this country, and it should not be taken for granted that it was inferior to the Minie rifle; in fact, in some respects the needle gun was superior to the Minie. Many of the Russians were armed with the Prussian needle gun, and used it very effectively, for with this gun they had picked off single men walking along the banks of the Danube, at a distance of 1500 yards. The needle gun was in great favour in Prussia, 50,000 having been issued to the Prussian army, who, armed with this weapon, were very formidable opponents. The lecturer remarked that in this country the proof of gun barrels was very lax, for after a barrel came from the proof-house it was often filed down to fit the stock; but in France and other countries it was required that the gun should be nearly completed before it was sent to the proof-house, and consequently greater security was obtained, from the barrel not being afterwards tampered with. The public, however, might know whether a gun barrel had been filed down after it left the proof-house by the distinctness or indistinctness of the stamp. The lecturer concluded by stating some interesting facts respecting the immense quantities of gunpowder consumed in a given time at various battles and sieges, and by alluding to certain experiments which had been made relative to the advantages of gun cotton.

To Correspondents.

ERRATA IN MR. LAWES' PAPER.—Page 271, on the eighth line of figures from the bottom, for 48·10 read 45·62; for 3·083 read 2·737; for ·556 read ·581; for ·410 read ·456; and on the last line of figures, for ·157 read ·057.

In the discussion on the Sewage of London, Mr. Higgs referred (page 324, col. 2, line 34) to works about to be opened at *Tottenham, Middlesex*, instead of at *Nottingham*, as reported.

At page 325, 2nd line of the last paragraph of Mr. Morton's letter on Italian Ryegrass, for *soil* read *evil*.

MEETINGS FOR THE ENSUING WEEK.

MON. Royal Inst., 3. General Monthly Meeting.
Architects, 8.
Entomological, 8.
TUES. Horticultural, 3.
Civil Engineers, 8. Renewed Discussion upon Mr. Robinson's Paper "On the Application of the Screw Propeller to the larger class of Sailing Vessels."
Linnæan, 8.
Pathological, 8.
WED. Society of Arts, 8. Mr. Herbert Mackworth, "The Diseases and Accidents of Miners."
Geological, 8. Sir. R. I. Murchison, "On the Comparative Geology of the Paleozoic Rocks of the Hartz, the Thuringerwald, and other parts of Europe.
Pharmaceutical, 8½.
THURS. Photographic, 8.

PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS.

Par. No.

Delivered on 20th of March, 1855.

110. Local Acts (8, Somerset Central Railway; 9, Dundalk Harbour and Port; 10, Sunderland Dock; 11, East Kent Railway; 12, East of Fife Railway; 13, Stokes Bay and Isle of Wight Railway, &c., &c.; 14, Fergus Estuary Reclamation; 15, Dagenham Docks;)—Reports from the Admiralty.
113. Linseed, &c.—Return.
Arctic Expeditions—Further papers.

Delivered on 22nd March, 1855.

61. Works and Public Buildings—Abstract Accounts.
62. Woods, Forests, and Land Revenues—Abstract Accounts.
120. Sugar—Return.
122. Army (Officers Promoted)—Return.
125. Metropolitan Water Companies—Further Reports.
36. Statute Law Commission—Return.
Prisons (Scotland)—16th Report of the General Board of Health.

Delivered on 23rd March, 1855.

124. Court of Chancery—Return.
59. Bills—Education (No. 2.)
60. Bills—Metropolis Local Management.
62. Bills—Newspaper Stamp Duties.
Church Estate Commissioners—4th General Report.
Ecclesiastical Commissioners for England—7th General Report.

Delivered on 24th and 26th March, 1855.

126. Military Medical Officers (Turkey)—Return.
128. Guano—Return.
130. Promotions (Marine)—Copy of a Royal Warrant.
131. Railway and Canal Bills Committee—2nd Report.

PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, March 23rd*, 1855.]

Dated 17th February, 1855.

358. H. P. Haughton, Bethnal-green—Wearing apparel for the ankles.

Dated 20th February, 1855.

374. F. B. E. Beaumont, Upper Woodball, Barnsley, Yorkshire—Revolvers.

Dated 1st March, 1855.

451. J. Ramsbottom, Accrington, Lancashire—Steam-engines and motive power.

Dated 5th March, 1855.

482. J. Gledhill, Congleton, Cheshire, and R. Gledhill, Halifax—Preparation of Silk, Flax, and other fibrous substances, and in the machinery employed therein.
484. W. Johnson, 47, Lincoln's-inn-fields, and Glasgow—Coating iron and steel wire with other metals or alloys. (A communication.)
486. A. Hotchkiss, New York, U.S.—Projectiles.
488. Arsène Louis Garnier, Guernsey—Photography, denominated Systême Garnier de Photocherographie coloriée.
490. R. Van Valkenburgh de Guinon, Brooklyn, State of New York, U.S.—Anchors.
492. J. Wood, 30, Barbican—Ornamenting woven fabrics for bookbinders and others.

Dated 6th March, 1855.

494. W. Hyde, Spring-hill, Ohio, U.S., 17, Cornhill—Marine life-preserving apparatus.
498. J. Player and L. D. Jackson, 2, Winchester-buildings—Furnaces for the prevention of smoke.
500. T. Lawson and M. Thompson, Gateshead-on-Tyne—Consumption or prevention of smoke.

Dated 7th March, 1855.

502. J. Kennedy, Liverpool—Manufacture of boots and shoes.
503. J. Higgins and T. S. Whitworth, Salford—Small arms, hardening articles of metal.
504. J. Cooper, Birmingham—Joiners' braces and bits.
505. W. Weild, Manchester—Looms for weaving pile fabrics.
507. J. W. Sloughgrove and J. H. Wheatly, Windsor-street, Islington—Smoke consuming furnaces.
508. J. M. Napier, York-road, Lambeth—Machinery for manufacturing balls for small arms.

510. J. Wilson, Hurlet, county of Renfrew, and J. Horsley, Cheltenham—Manufacture of iodine and iodides, and of a pigment or pigments therefrom.

Dated 8th March, 1855.

511. B. L. F. X. Flechelle, Paris—Porte-monnaies.
512. L. E. Bataille, of Paris—Looms for weaving pile-fabrics.
513. G. C. Reitheimer, Holyhead, Anglesea—Means of loading or discharging fire-arms.
514. T. Walker, Birmingham—Rotary engines by steam or other fluid.
515. A. F. J. Claudet, Regent-street, Westminister—Stereoscopes.
516. G. Hazeldine, Lant-street, Southwark—Wheel carriages and wheels.
517. A. Krupp, Essen, Prussia—Construction of railway wheels.
518. J. Brooks, Bury, Lancashire, and Walter William Stephen—Looms for weaving.
519. J. Taylor, Spring-grove, Isleworth—Packing and preserving eggs and other articles of food.
520. H. Gilbert, Kensington—Hurdles.
521. J. and S. Aitken, and J. Haslam, Bacup, Lancashire—Machines for preparing, spinning, and doubling cotton, wool, flax, silk, &c.
522. J. Norton, Dublin—Fire-arms and ammunition.
523. W. Foster, Black Dike Mills, Bradford — Machinery for drying wool, &c.
524. W. Foster, Black Dike Mills, Bradford—Machinery or apparatus for cleansing wool, &c.
525. J. Bernard, Club Chambers, Regent-street—Manufacture of boots and shoes, and machinery for same.
526. J. Gerard, Guernsey—Portable floating pier, &c.

Dated 9th March, 1855.

527. G. White, 5, Laurence Pountney-lane, Cannon-street — Treatment of horn, &c. (A communication.)
528. P. Dall, Woolwich—Self-acting indicating and recording mechanism for steam-engines.
529. J. Bullough, Accrington—Looms and apparatus for weaving.
530. J. Murdoch, 7, Staple-inn, Holborn—Shade or reflector for lamps. (A communication.)
531. J. Murdoch, 7, Staple-inn, Holborn—Method of enlarging or reducing designs, maps, &c., and machinery for same. (A communication.)
532. F. A. Barnet, Nelson-street, Bristol—Manufacture of metallic bedsteads and couches for the use of invalids, &c.
533. T. Hill, the Birches, Stanton Lacey, Shropshire—Machinery for the manufacture of bricks, drain-pipes, tiles, &c.
534. S. Lister, Manningham, Bradford—Treating and preparing the fibres of flax, hemp, &c., for spinning.
535. G. Bousfield, Sussex-place, Loughborough-road, Brixton — Preparing wool, &c., for spinning. (A communication.)
536. S. C. Lister, Manningham, Bradford—Combing the noil of silk waste.
538. S. C. Lister, Manningham, Bradford—Machinery for combing wool and other fibres.

Dated 10th March, 1855.

540. W. Mickle, Willington, Durham—Smelting or production of iron from its ore in blast furnaces.
542. J. Sunderland, Marsden, near Burnley—Self-acting apparatus for regulating the flow of liquids from casks.
546. R. Brisco, Low Mill House, St. Bees, Cumberland, and S. Horseman, St. John's Beckermet—Preparation of flax.

Dated 12th March, 1855.

548. D. H. Brandon, 11, Beaufort-buildings, Strand—Machinery for cutting fustians, &c. (A communication.)
550. J. Hulls, Plaistow, Essex, and J. Lowe, Lambeth-road — Coating iron and other metals with lead.
552. J. Gilbert, Engine Works, Boston-street, Hackney—Pump or pumping apparatus.
554. W. Score, Bristol—Bleaching oils, fats, and resin.

Dated 13th March, 1855.

556. D. Macaire, Paris—Casks and taps.
560. S. Swingle, Aston-juxta-Birmingham—Metallic spoons, forks, and ladles.
562. A. V. Newton, 66, Chancery-lane—Engine to be actuated by the expansive force of explosive mixtures. (A communication.)

WEEKLY LIST OF PATENTS SEALED.

Sealed March 23rd, 1855.

2066. Louis Cornides, 4, Trafalgar-square, Middlesex—A new mode of manufacturing a transparent medium, plain, printed, and coloured, of gelatine in combination with other substances.
2075. Charles Barraclough, Halifax, Yorkshire—Improvements in machinery or apparatus for the manufacture of clog soles and patten soles by power.
2085. William Hutchinson and William Barlow, Salford—Improvements in steam boilers.
2087. George Crux, Manchester—Improvements in the production of bonnets, children's hats, and similar coverings for the head.
2115. Christopher Hill, Chippenham, Wiltshire—Improvements in the manufacture of pulp.
2133. Aimé Antoine Joseph Legentil, Arras, France—Certain improvements in pumps or machinery for raising and forcing water and other fluids.
2155. George Thomas Selby, Smethwick, Staffordshire—An improvement in furnaces.
171. Peter Arkell, Stockwell, Surrey—An improved mode of purifying whale and seal oils.

Sealed March 27th, 1855.

2086. William Beckett Johnson, Manchester—Improvements in lamps and other apparatus used for illumination.
2094. Walter Sneath, Derby-road, Nottingham—An improvement in sewing machines.
2100. Gémis Filhon, Paris—Improvements in glass chimneys for gas burners or lamps.
2101. Thomas Collins, Gayton, Northamptonshire—Improvements in manufacturing bricks and tiles.
2108. William Woods Cook, Rumforth, near Bolton, Lancashire—An improved method of weaving or manufacturing woven fabrics suitable for petticoating or similar purposes, where thick and thin parts of the same fabric are required.
2118. William Tatham, Rochdale—Improvements in machinery or apparatus for preparing, spinning, doubling, twisting, and winding cotton, wool, flax, silk, and other fibrous substances.
2120. John Jeyes, Northampton—An improvement in the manufacture of paper, threads, and yarns.
2131. William Peel Gaulton, Cray Works, near Macclesfield—Improvements in breaks applicable to railway carriages and other vehicles.
2135. Thomas Prosser, New York, U.S.—Improvements in the manufacture of certain hollow closed vessels, and in the machinery or apparatus employed therein; parts of which improvements are also applicable when preparing for and fastening tubes into steam-boilers, or other vessels requiring tubes to be fixed therein.
2145. Thomas Bennett, Woodbridge-street, Clerkenwell—Improvements in the apparatus employed in the manufacture of gold, silver, and metal leaf.
2148. François Durand, Paris, and 4, South-street, Finsbury—Certain improvements in circular looms.
2154. Robert Way Uren, Fogginton, Devonshire—Improvements in machinery for the manufacture of bricks and tiles.
2166. Samuel Hancock, Woolaton-street, Nottingham—Improvements in the manufacture of looped fabrics.
2210. Etienne Bernot, Paris, and 4, South-street, Finsbury—A new machine for cutting files, which he calls "Bernot's file-cutting machine."
2239. Thomas Biggart and Allan Laudon, Dalry, country of Ayr, N.B.—Improvements in regulating motive-power engines.
2315. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in lithographic printing presses. (A communication.)
2366. Charles William Siemens, John-street, Adelphi—Improvements in electric telegraphs.
3399. Peter Armand le Compte de Fontaine Moreau, 4, South street, Finsbury, and 39, Rue de l'Echiquier, Paris—Improvements in fire engines.
2759. George Edward Dering, Lockleys, Hertfordshire—Improvements in obtaining motive power when using electric currents.
11. George Peacock, Gracechurch-street, London—Improvements in constructing propellers for ships and other vessels.
66. Henry Bessemer, Queen-street-place, New-Cannon-street—Improvements in the manufacture of iron and steel.
73. Edward Hall, Dartford, Kent—Improvements in the manufacture of gunpowder.
75. Elmer Townsend, Massachusetts, U.S.—New and useful improvements in machinery for sewing cloth, leather, or other material. (A communication.)
146. John Irwin Clarke, Windsor-court, Monkwell-street—Improvements in applying colour to the edges of leather gloves. (A communication.)
155. William Douglas and John Carswell, of Manchester—Improvements in dyeing woven fabrics.
201. William T. Vose, Massachusetts, U.S.—New and useful improvements in pumps for elevating fluids.
202. Isaac Atkin and Marmaduke Miller, Nottingham—Improvements in apparatus for measuring the supply of water and regulating the supply of fluids.
220. Arthur Collinge, 65, Bridge-road, Lambeth—Improvements in spring hinges.
223. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the generation of steam. (A communication.)

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

No. in the Register.	Date of Registration.	Title.	Proprietors' Name.	Address.
3699	March 23.	Wheatman's Mill Saw Key Tiller	Wheatman and Smith	Sheffield.
3700	„ 24.	Hospital Stove................................	Price's Patent Candle Co....	Belmont, Vauxhall.